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BUTTER MAKING ON THE FARM.

BY

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., December 1, 1905.

SIR: I have the honor to transmit the following manuscript entitled "Butter Making on the Farm," by Edwin H. Webster, M. S., chief of the Dairy Division of this Bureau. The subject is of much importance in relation to farm economy, and as it is desirable to place the information which the work contains in the hands of as many of our dairymen and farmers as possible, I recommend its publication as Farmers' Bulletin No. 241, superseding Farmers' Bulletin No. 57, bearing the same title.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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BUTTER MAKING ON THE FARM.

The principles of making butter are easily understood. When studied from the standpoint of present knowledge, most of the mystery that formerly surrounded the work of the butter maker disappears. The making of good butter is not a system of "rule of thumb," but certain well-defined laws can be laid down, which, if followed, will insure success. Formerly the butter maker had no system of reasoning that would show why his results were obtained. To-day every step is taken with knowledge and reason, and the result is practically determined beforehand.

On the farm the maker has control of every step in the process of making butter. Beginning with the supposition that the cows are normal and healthy, he starts with one ideal condition, namely, a source of pure milk. As the milk is drawn from the udder it should be free from any element that would cause its decomposition, but the fact that it will in a few hours become sour or show evidence that other changes have taken place proves that a foreign element is present to produce these changes. A study of these changes and their cause is the first and most important lesson for the butter maker.

CAUSE OF CHANGES IN MILK.

Everyone is familiar with the changes that often take place in milk and those which occur in the spoiling of fresh meats and vegetables, though the causes that produce these changes may not be apparent to the observer. It is also a matter of common experience that in hot moist weather these changes take place with much greater rapidity than in cold or dry weather. Everyone who has handled milk has learned that cleanliness in everything that comes in contact with it is one of the essential factors to success. Cold storage, such as may be supplied by the common household refrigerator, is also necessary for the keeping of milk and other perishable products in hot weather.

The cause of the spoiling of fruit, vegetables, meats, and milk was found to be minute plant life, or germs, called bacteria. It was discovered that these minute forms of life—so small that it takes a powerful magnifying glass to see them—were the cause of all decomposition. A study of their life, habits of growth, the food on which they lived, the kind of substance on which they could develop, and the temperatures most favorable to their growth revealed the scientific necessity for observing perfect cleanliness in all dairy utensils and for keeping the milk cold. It was found that bacterial life is in evidence everywhere, and only awaits the proper food, moisture, and warmth to cause the bacteria to multiply very rapidly. Just as a grain of corn grows when given proper moisture and warmth, so the germ life that finds its way into milk utilizes the food and warmth found there to grow and multiply, causing decomposition.

It has been found that when milk or other perishable foods are kept free from bacteria they will not spoil; and, further, that foods of this nature when kept at low temperatures are very much longer in spoiling, although they may contain great numbers of germs. When milk and other products are heated to a high temperature the bacterial life is destroyed, and the products will keep for a long time if no additional bacteria gain access to them.

The application of this knowledge forms the greater part of the science of butter making. The great amount of poor butter made on the farm indicates that some or all of these facts have either been misunderstood or ignored. Fortunately many species of bacteria known to exist are not harmful in milk. Many are beneficial in that they develop flavors desirable in good butter. From this it appears that the knowledge of methods necessary to check or destroy bacterial development is but a part of the butter maker's art. He must know how to promote the growth of the desirable kinds. Up to the point of ripening the cream the whole process is one of retarding the development of bacteria by cleanly methods and the use of cooling devices. When the ripening process begins the growth of favorable kinds is encouraged.

MILKING THE COW.

Things for milkers to think about.—Too many milkers regard the work of milking as a dirty, disagreeable task. The work has resolved itself into nothing more than the manipulation of the udder, and is to be hurried through with as quickly as possible. The element that takes from all drudgery its unpleasantness is wanting. That element is thinking along lines tending to improve the work. In the processes that attend the milking of a cow there is enough to cause the milker to study seriously the work that leads up to the making of a perfect

pound of butter. Milk as it is drawn from the udder is nearly free from bacteria. Could it be kept in this condition it would keep for many hours before any perceptible change would take place.

The first bacteria enter during the time of milking and are naturally from the cow and her surroundings. The manipulation of the udder works off hair, particles of skin, and in many instances particles of manure that adhere to the hair and udder. All of this material finds its way into the milk pail and carries with it great numbers of bacteria. The warm temperature and the presence of a congenial food supply that is in just the right physical condition cause these bacteria to multiply very rapidly, and unless something is done to check their growth souring or other evidence of decomposition will take place in a few hours. The rapidity with which these changes occur will depend almost entirely upon the temperature at which the milk is allowed to stand and the number of bacteria that find entrance to it. These facts are constantly in the mind of the careful dairyman. He knows that the first step is that of prevention. The work of milking should be performed in such a way that few bacteria will find their way into the milk. The milk should be cooled quickly and thoroughly immediately after it is drawn, in order to check the growth of those bacteria that will, under the best conditions, find their way into it.

Cleaning the cow.—All this leads to the conclusion that the cow must be carefully cleaned. This is as good for her general physical well-being as for the protection and purity of the milk. The card or the currycomb thoroughly but gently applied will remove all coarse dirt, straw, or other matter clinging to the animal that would eventually find its way into the pail. Aside from carefully cleaning the cow with the card or currycomb, the parts immediately surrounding the udder and the udder itself should be wiped with a damp cloth. This had best be done just before the milking begins, as it will remove most of the dust which may still remain after carding and dampen that which is not removed, so that it will not fall into the milk pail. If the milking is to be done in the barn there are some other important things that need attention. The air in the milking place must be free from dust—it matters not whether the dust comes from the floor as a result of its recent cleaning, or whether the animals have stirred up the dust in coming into the stalls, or whether it is caused by the distribution of feed in the racks and boxes. Dust in the air will find its way into the milk, bringing with it great numbers of bacteria. If the floors are dusty they should be lightly sprinkled, so as to prevent the stirring of the dust. Feed should not be distributed just before or during the milking hour.

Clean milkers.—Another thing of importance in connection with milking is the condition of the hands and clothes of the milker. He

should be clean personally, and should be required to go about his work in clean clothes. The milking should be done with dry hands. The habit of some milkers of wetting their hands with milk just as they begin is a filthy practice and the cause of much bad milk and poor butter. There is something in the presence of a milker in a white suit that calls for clean work, particularly if he is required to keep the suit clean while about his work. For this reason, as well as for the esthetic effect, many dairymen require their milkers to be dressed in white. The same principle is true in regard to whitewash on the interior of the barn. A carefully whitewashed wall shows off cobwebs to their disadvantage, and they will usually be removed. There is something out of place if part of a building is kept clean and fresh—as a whitewashed wall, for instance—and other parts are a mire of filth. Whitewashed walls go with clean floors, and the two with a white-clad milker will usually insure clean milk.

THE BARN.

Construction and care.—It will be seen from the preceding paragraph that the barn and its care have an important influence in the production of pure milk. As it is impossible to secure pure milk in a dirty dark barn reeking with odors of manure, its construction must be taken into account. Plenty of air space must be provided in order to insure pure air, from 900 to 1,000 cubic feet being needed for each animal. An abundance of window space must be provided. Enough light should enter to enable one to read a newspaper in the darkest places. The ventilation should be such that the air is changed every few minutes. Anyone contemplating a new barn or a reconstruction of an old barn to conform with the ideas here mentioned should secure some good treatise on barn construction and ventilation. It is evident to any observer that one of the difficulties in securing good milk is the dark, poorly ventilated and constructed barns, containing rotten wooden floors that can not be cleaned. Concrete is the best material for floors. It is economical and can be easily kept clean. If wood is used in floor construction, it should be closely laid in pitch and kept in perfect repair. The interior of the barn should be kept well covered with whitewash, which acts as a purifier and makes the rooms much lighter. Stalls and feed boxes should be simple in construction and easily cleaned.

Objections to bank barns.—As a usual thing bank barns are not good dairy barns unless the stalls are placed on the floor entirely above ground and the basement is used for storage of implements or purposes of similar nature. A basement as ordinarily constructed is dark and damp and has low ceilings. It is difficult to ventilate and is entirely unfit for housing animals. The drainage of the yards around

the barn is very important. Yards must be dry and firm. An accumulation of manure in the yards is very objectionable. The dairyman who compels his cows to wade knee-deep in manure before they can get into the barn can never expect to secure good milk. If all dairy barns were so built as to be light and airy, admitting lots of sunshine when needed, and were kept in good sanitary condition, there would be less tuberculosis and other diseases among the dairy stock.

MILK UTENSILS AND THEIR CARE.

Character of utensils.—Not all of the bacteria that find their way into milk come from the cow or the barn. Often milk pails, strainers, cans, and other utensils used for handling milk are the source of such trouble. Faulty construction of these vessels is very common. There should be no hidden, inaccessible places in milk vessels. The seams should be soldered over smoothly, inside and out. Cheap tinware is not usually well soldered, and if such is purchased it should be taken to the tinner to have all seams carefully gone over, closing up all that are open and can not easily be cleaned. Galvanized iron is sometimes used for milk pails and other dairy vessels, but it should not be, as the galvanizing is rough on the surface and affords hiding places for innumerable bacteria. Wooden vessels should not be tolerated, under any condition, for holding milk, for it is impossible to keep them clean. Rusty tinware, besides its effect in imparting rusty or metallic flavor to the milk, is objectionable for the same reason. Good tin is the only practicable material for milk vessels, and this must be kept shining and bright.

Cleaning the utensils.—The proper washing of milk utensils is something that is often misunderstood. All milk should be rinsed from the surface of the tin before it comes in contact with boiling water, as the heat will cook the milk onto the surface, forming a coating very difficult to remove. If this coating is not removed, it furnishes food and place for bacterial growth. This is especially true around places liable to remain moist. After rinsing the vessel free from milk, it may then be washed in hot water. There should be added to the water some good cleansing compound. Some of the so-called washing powders are very objectionable, as grease of some kind is used principally in their make-up. When such powders are used a coating of thick grease will be formed around the edges of the sink or pan containing the wash water. All such compounds should be discarded. Powders can be procured that are guaranteed to contain no grease, and they are usually excellent cleansers. If these are not obtainable, the best thing to use is ordinary commercial sal soda and a little borax, which are cheap and effective.

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For scrubbing the surfaces of milk vessels a good brush should be used. There is nothing more objectionable for this purpose than a cloth, particularly the cloth that has been used for washing the dinner dishes, or the pots and pans. A good hand brush can be purchased for a few cents. It is the most effective and can easily be kept clean.

Drying and sunning utensils.—The final rinsing of dairy vessels should be in boiling hot water. If they are allowed to remain a few minutes in the hot water, all the better. The heat will reach every part, and be continued long enough to destroy all bacterial life. After the rinsing in boiling water, the surface will quickly dry and should be allowed to do so naturally. Turn the vessel so that it will drain, and in a few moments the heat in the metal will dry the surface. A cloth for drying can rarely be kept clean, and for this reason does more harm than good. It is an excellent practice to stand the pails and other milk vessels in the sun so that the rays will reach every part of the inside. Most species of bacteria can not live in the direct rays of the sun. For this reason milk rooms and similar rooms for handling milk products, except cold-storage rooms, should be built so that the sunlight can enter in abundance. Dairy rooms are usually damp, and if dark will permit the growth of molds and the development of bacteria, and will speedily become unfit as places to keep milk. The troubles with stringy, or ropy, milk usually occur in places of this kind, and can be overcome by a thorough cleansing and the admission of plenty of air and sunlight.

HANDLING OF MILK AFTER IT IS DRAWN.

Milk is often spoiled by allowing it to stand in the barn too long after it is drawn. It readily absorbs odors from the air, and odors of the barn are usually very much in evidence. For this reason the milk should be quickly removed to a place free from odors.

The milk room.—If milk is placed in a cellar or cave where there are decaying vegetables or fruits it will quickly absorb the odors from them. Such places are entirely unfit for the storing of milk. The dairyman should have a building set apart from the barns or other places from which objectionable odors might come, for the exclusive use of the dairy. This building need not be very large, but must be constructed so that it can be easily kept clean and cool. A cement floor should be laid, as it is the easiest to clean, is cool, and does not rot from moisture. If the walls are built of stone, brick, or concrete, so much the better, for such walls keep out the heat.

The roof construction should be such that it will effectually turn the heat of the sun. If the roof is not of concrete, it should be built double so that an air current will pass between the upper and lower

part. Walls and ceilings should be covered with cement plaster, whether wood or stone is used in their construction. This finish, if properly put on, is easy to clean and does not readily become affected with mold or decay.

The water supply.—Provision must be made for an abundance of water and the pumping arrangement must be such that the fresh water from the well or spring will flow through the dairy house. It should run into a tank built deep enough to allow the complete submerging of the milk and cream cans. The tank should have sufficient width and length to hold all that it may be necessary to use. A tank built up of concrete and finished with a cement surface is the most economical in the long run and is much more satisfactory. Provision must be made for draining it out for purposes of cleaning. Wooden tanks are usually a source of trouble from leaks and decay. Iron tanks do not last long, because they become rusty.

Cooling arrangements.—If the dairyman has ice, the problem of cooling is very simple. Broken ice can be placed in the tank about the cans. There are plans for building ice houses with refrigerators connected, but, all purposes considered, the refrigerator can be built with most economy and with better sanitary arrangement if it is constructed separate from the ice house. The common ice chest in which the products to be cooled are placed in the box with the ice is a very satisfactory way for handling cans of milk or cream. For other products it is not so satisfactory, as it is not dry enough, and if the articles are small does not afford shelf room for them.

Use of steam.—In a moderate-sized dairy there should be added to the equipment a small steam boiler which should be in a room separate from the dairy. There is always need of steam, and the additional cost involved is but little compared with the benefits obtained. If steam can not be provided, a small hot-water heater of some kind should be used. It is essential to have plenty of boiling water for purposes of washing and scalding milk vessels and the floors and walls of the building.

It is not within the province of this bulletin to go into details of construction in the matter of dairy buildings. The ideas here given are general in nature and involve principles that should be followed in any construction.

THE CREAM SEPARATOR AND ITS OPERATION.

Advantages of mechanical separation.—There are two general methods in practice for creaming the milk. One is to place the milk in shallow pans or deep cans and allow the cream to rise by gravity. The other is the use of the centrifugal separator. As the separator is fast

displacing the old method, space will be given here for a discussion of separation by centrifugal force only.

The dairyman can not afford to be without a separator. It removes practically all of the butter fat from the milk, while the old method of gravity skimming will leave from one-eighth to one-fourth of the butter fat in the milk. The cream from the centrifugal machine is of finer quality, and a much better product can be made from it. The skim milk is fresh and sweet for feeding and is far superior to that from the gravity system.

There are numerous kinds of mechanical separators on the market, but they differ in details of construction rather than in the principles on which they work. The dairyman should thoroughly understand these principles. In selecting a separator one should first determine its value for good work, and then examine its mechanical construction to see if it will stand long use.

The principles of separation.—The force that is used to separate the milk is known as centrifugal force. This force may be described as the pull that is felt when a weight attached to a string is whirled about the hand. It is the pull outward, and the faster the weight is whirled the stronger the pull becomes. In the old system of creaming, the separation is caused by the action of gravity. The fat globules, being lighter than the other portions of the milk, are forced to the top; that is, gravity acts stronger or pulls harder on the heavier portions than it does on the lighter, and the milk is gradually arranged in layers, the lighter portion at the top and the heavier portion at the bottom. The force acting in the separator has precisely the same action on the milk, but acts outward from the center of the bowl the same as gravity acts downward from the surface, only many thousand times stronger, accomplishing in a few moments and far more completely what it takes gravity several hours to do.

As the milk goes into the bowl it is at once thrown to the outermost parts and fills the bowl completely until an opening is reached where it will flow out again. The surface of the milk is on a line parallel with the center, or axis, of the bowl, and is exactly in line with the cream outlet. A cross section through the bowl from this surface to the outside presents much the same appearance as would a pan of milk after the cream has raised by gravity. The cream is on the surface, which might be called the top, and the heavier portions of the milk at the point farthest from the center, which would represent the bottom.

With this understanding of the arrangement of the milk in the bowl there are a number of things to be observed which influence the separation. The difference in length of time it takes to separate cream by gravity and by centrifugal force shows plainly that the time varies

with the amount of force applied. The snorter the time the greater the force must be. Skim milk from the separator contains less fat than that secured by the gravity system, showing that the greater force causes more perfect separation.

From the above statements the following conclusions regarding the use of the separator may be drawn: (1) If the amount of milk that passes through the separator in a given time is a fixed quantity, any increase in the speed of the machine will tend to cause closer skimming because of the greater force exerted; (2) if the amount of milk that passes through in a given time is increased and the speed remains the same the skimming will not be so perfect, for the centrifugal force is not exerted on the milk so long a time. It is evident, therefore, that the closeness of skimming is the result of two factors—time and force. If either of these is decreased, the result will be poorer work. If either is increased, better work will result.

Common errors in operating separators.—Two errors are made in operating separators because of ignorance of the facts just stated. The first consists in allowing too much milk to pass through the machine. As there is a limit to the practical speed at which the machine can be safely run, it is not good practice to try to overcome the error referred to by increasing the speed beyond the safe point. The feed outlet is usually fixed so that too much milk will not run through, but cases have been known where operators, anxious to shorten the time of separation, have enlarged the opening, allowing too much milk to pass. This error is not so common as the second, which is to allow the speed of the machine to become too slow. The slow speed does not generate enough force to skim properly, and the result is loss of butter fat in the skim milk. The number of revolutions per minute required by a machine is usually indicated on the machine or in the instruction book belonging to it, and this should be strictly followed.

Best temperature of milk for separating.—All liquids flow more readily when warm than cold. This is not as noticeable with milk as it may be with molasses, but the principle holds just as true and is readily shown in the separation of milk. Everyone has observed that cold cream does not flow as readily as warm cream. As cream is one of the products of separation and has to flow from the machine through a small opening or outlet, it is seen that the warmer it is the more readily it will flow. If the flow of cream is checked, more milk will be forced out of the skim-milk outlet, and if the obstruction to the flow becomes too great, butter fat will go out with the skim milk, because it can not move fast enough through the cream outlet. For this reason the nearer the temperature of the milk approaches the animal heat the better will be the separation. While some machines

are supposed to skim milk as cold as 60° to 65° F., it is not good practice, because the skimming will not be so close. The milk should be at a temperature of 80° or higher. It will be seen, therefore, that a third factor, in addition to rate of feed and speed of machine—namely, the temperature of the milk—has a direct bearing on separation, and it may be accepted as true that the warmer the milk the better the work.

Regulating the flow.—All separators are supplied with some device for regulating the proportion of cream to skim milk. In some this is done by adjusting the cream outlet, while in others the adjustment is in the outlet for skim milk. The principle on which the adjustment is based is not difficult to understand. In the arrangement of the outlets the difference of specific gravity of the cream and skim milk has to be taken into account. To again use the illustration of the string and the weight, it may be observed that the farther the weight is placed from the hand the harder becomes the pull on the string if the the same speed is maintained, and, similarly, the heavier the weight the harder the pull. If two weights are taken, one a little heavier than the other, and both are whirled about the hand, it is observed that the lighter weight would have to be farther out on its string to exert the same pull as the heavier weight.

In the separator bowl the outlet for cream and the outlet for skim milk have to be nearly the same distance from the center in order to retain the milk in the bowl long enough to allow the separation to take place. Cream is lighter than the skim milk, else there could be no separation, and this fact makes it necessary to place the cream outlet a little nearer the center than the outlet for skim milk. The skim milk is taken out at a point farthest away from the center of the bowl by means of tubes or a disk of some kind. The skim milk is the heavier and if the outlets were the same distance from the center would force most of the contents of the bowl through the cream outlet. In order to overcome this effect the skim-milk outlet is placed a short distance farther from the center of the bowl than the outlet for cream. This balances the two portions, so that the division of cream and skim milk is near the desired proportion.

From this it can be seen that any change in the relative position of these outlets changes this balance. If the cream outlet is moved nearer the center of the bowl, more milk is forced out of the skim-milk opening. If it is moved farther from the center of the bowl, more milk is forced through the cream opening. If the adjustment is made in the skim-milk outlet precisely the same thing occurs. If the outlet for skim milk is moved nearer the center of the bowl it forces more cream through the cream outlet, and as it is moved away

from the center of the bowl less cream will be forced through the cream outlet. When less cream is delivered it contains a greater percentage of fat than when a larger quantity is delivered. This is due to the fact that the skim milk is taken from the extreme outer edge of the bowl. Arranging the outlets so that greater or less quantities pass over this point to the skim-milk outlet does not change the character of the skim milk, but does change the quantity that is left to pass out with the cream, making more or less cream, which will test accordingly.

Sometimes dirt is allowed to accumulate in the skim-milk tubes or in the cream outlet. Any accumulations of this kind will change the percentage of butter fat in the cream and the proportion of skim milk to cream exactly as if there had been a change made in the position of the cream or skim-milk screws.

The various internal devices used in separators serve two purposes—they cause the milk to flow through the bowl in a uniform steady stream, and serve to divide or distribute it so that a greater surface is exposed at one time to the centrifugal action. The more evenly the distribution is made throughout the bowl and the quieter the currents of milk flow the greater will be the capacity and efficiency of the machine.

Summary of points to be observed.—To summarize, the points in the operation of a separator, given in their order of importance as bearing on the quality of the work, are as follows:

First. The speed of the separator must be uniform and up to the standard required by the makers of that particular machine.

Second. The temperature of the milk should be such as will make it flow readily; the warmer it is the more perfect will be the separation.

Third. The amount of milk that is run through the machine should remain constant, and should not be increased over that which is intended for the machine.

Fourth. The machine should be set on a solid base or foundation, so that there will be no jar or shaking about as it is turned, such as would tend to interfere with the even flow of the milk through the bowl and thus destroy its efficiency in skimming.

Fifth. The separator must be kept thoroughly and scrupulously clean, particular care being taken that none of the tubes through which the milk flows become obstructed in any way.

Sixth. The test of the cream can be readily changed by changing either the cream outlet or the skim-milk outlet.

In the mechanical operation of a machine none but the best oil should be used, and this should not be allowed to gum or become dirty on the bearings. It is good practice to flush the bearings with kerosene occasionally by making a run with kerosene in the oil cups. This

will serve to cut out any gum or dust that has accumulated in the bearings and will make the machine run much freer and easier, thus greatly increasing the length of time that it will last and do perfect work.

SEPARATING THE MILK.

The milk should be separated as soon as possible after milking, while it still contains the animal heat.

Use of strainers.—If milk has been handled in a cleanly way during milking it can be poured directly into the supply can of the separator without straining. The dairyman who depends upon the strainer to clean the milk rather than using cleanly methods of milking is the one who makes the poorer butter. If it is necessary to strain the milk a very fine wire strainer should be used. It is very difficult to keep a a cloth strainer in good condition, and if not kept in a good condition it is a seed bed for trouble. When a strainer cloth becomes yellow it rarely ever smells clean, indicating that decomposition is going on and that it is not fit to use. For this reason it is best to discard strainer cloths entirely. If a strainer other than wire is used, it is best to employ some material such as absorbent cotton that can be thrown away at the end of each milking.

Operating the machine.—Before starting the separator the operator should look carefully after the bearings or wearing parts, putting a drop or two of oil on each and noting whether the oil cups are dropping properly. Instructions for care and oiling come with each machine and they should be heeded. The makers have studied this problem and are bound for their own protection to give proper instructions for operation. In the winter time when the separator bowl and parts are cold it is best to pour a quart or so of hot water through the machine just as it is started. This warms up the surfaces and prevents the milk from sticking as it would if cold. It also makes the cleaning of the separator much easier and prevents its clogging up at the start.

Bring the machine gradually up to its normal speed and then turn the milk in slowly until the valve is wide open. Keep a constantly uniform motion of the handle during the entire run. When all of the milk has passed from the supply can a quart or so of the skim milk should be caught and poured through to flush out the cream that will remain in the bowl. Unless this is done some of the butter fat will adhere to the surfaces and a small amount remain in the center of the bowl, not being able to get out of the machine because there is no more milk flowing in to force it through. Pouring in the skim milk forces it all out. Warm water may be used for this purpose but usually it is not so convenient.

Care of cream after separation.—The first work on completion of the separation should be the care of the cream. It is the product for

which all of the previous work has been performed and it is worse than folly to neglect it now it is secured. The cream must be cooled at once to check the growth of bacteria. The best method for doing this is to place it in a deep, narrow pail immersed in cold water just pumped from the well, and then stir it gently until it is brought down to nearly the temperature of the water. A good dairy thermometer must be a part of the equipment of every dairy, and all temperatures should be taken with it—not by guess. It will take but a few minutes to cool the cream down in the manner described. As soon as it is cooled cover the pail in such a way that it can be entirely submerged in the water. The ordinary shotgun can, as it is commonly called, having a cover that fits over the outside coming down about 2 inches, with catches to hold it in place, is the best kind of a vessel for cooling and holding cream. When a can is entirely submerged it is protected from the heat of summer, the cold of winter, and the contaminating odors that may be in the air; and the surface is effectually kept from drying, leaving the cream in as fine physical condition as when separated.

Warm cream should never be mixed with cold. The result of mixing is always quick souring. The bacteria in the cold cream are dormant or inactive and will remain so if kept chilled. Just as soon as the temperature of the cream is raised a little it quickens the life of the bacteria and they increase at a rapid rate, causing souring in a very short time. Too much emphasis can not be given to the two points above mentioned—namely, the quick and thorough cooling immediately after separating and the caution in regard to the mixing of the warm and cold cream. It is of more importance to attend to the cream at once after the separating is finished than anything else at that particular time. The calves and pigs can wait for their skim milk, but bacteria in the cream wait for nothing until the temperature favorable to their growth is reduced.

In hot dry climates, where evaporation is excessive, another method for keeping milk or cream cool may be adopted. After the cream has been cooled as described, instead of submerging the can in a water tank it can be set out in the open under anything that will protect it from the sun. A pail of water should be set on the lid. A cloth stitched along the edges to form a sack must then be dipped in the water and slipped down over the pail and can, bringing it clear to the floor, with the upper end turned down into the water. This cloth or sack serves as a siphon and will gradually empty the pail, the water moving up the edge and down to the floor. From a cloth thus kept wet the evaporation will be very great, and the can and its contents under the cloth will be kept cool even in the hottest weather. In fact, the hotter and drier the air the greater the cooling effect, as there will be more rapid evaporation.

In using the tank for keeping cream cool, it must not be forgotten that the water must be kept fresh. If a constant stream is not running through the tank the water should be changed at least twice or three times during the day. The frequency should depend upon the coolness of the room in which the tank is kept.

Cleaning the separator.—Very soon after the separation has been completed the separator should be cleaned. It is imperative that it be washed every time after it is used, and the sooner it is washed the easier will be the operation. The general directions for washing dairy tinware apply to the parts of the separator that come in contact with the milk. In cleaning the machine the frame should not be neglected. Sometimes an operator thinks it is useless to spend time to keep it clean, as it does not come in direct contact with the milk. In most cases where a machine is found to be dirty and grimy, it will be found out of repair in other ways. The bearings will usually be gummy, and if examined the machine will be found to be out of level, and more often than otherwise the parts that come in contact with the milk will not have been properly cleaned.

RIPENING THE CREAM.

Up to the point of ripening the cream the dairyman has been trying to keep his cream as free as possible from bacteria and to check the growth of all that may get into it, but from this point on the work will be quite different. Cream prepared as described in the foregoing paragraphs should be perfectly sweet, and if cooled properly will remain so for a number of hours. In fact it can be preserved four or five days if kept at a temperature below 50° F. It might be churned in this condition and a quality of butter made that is in demand in a limited way, but, practically speaking, all butter used in this country is churned from sour cream. Sweet-cream butter to most users tastes flat and insipid.

The starter and its use.—The dairyman may think, if it is necessary to sour the cream, why is all this pains taken up to this point to keep it sweet. The trouble with ordinary souring is, it may not be the desirable kind. It must be handled in such a way that desirable flavors will be developed and the undesirable ones kept in check. This can only be done by starting with a perfectly sweet cream and afterwards controlling the souring process. This control is secured by introducing into the cream what is known as a starter. A starter is nothing more nor less than nicely soured milk, either whole or skimmed. It will contain those kinds of bacteria that will develop the good flavors wanted and not those that cause putrefaction, gassy fermentations, and similar undesirable changes. As has already been stated, the

greater number of bacteria present are the favorable kinds, and when milk is handled in a cleanly manner practically all that find entrance are of these kinds. To secure a starter containing desirable bacteria, the dairyman has simply to set away a portion of skim milk as it comes from the separator and await developments. If the milk is kept at a temperature between 70° and 80° F., it should sour inside of twenty-four hours and form a solid curd. A test of this curd shows whether or not the dairyman has kept his milk clean. If the taste is found pleasant and mildly acid and the curd readily breaks up when poured from one vessel to another, becoming creamy, showing no hard lumps that will not break down, he has a good starter. On the other hand, if the curd is stringy or will not break with a square, sharp cleavage, but seems to be granular, or if a clear whey is formed on the surface, it shows that bacteria of a harmful species are present. The formation of this curd is caused by the development of acid in the milk. If the souring continues too long and too much acid is formed, the starter becomes sharp and unfit for use. After a certain amount of acid is formed its further development is checked, but this does not occur until the milk is too sour for a good starter.

The starter is at its best just as the curd becomes firm, and the butter maker should plan to have this occur at the time he wants it to put into the cream. A glass jar is the best vessel in which to make a starter. The glass surface, being smooth, is easily cleaned, and the butter maker can see what action is taking place while the milk is souring. If there are gas-producing germs in the milk, little bubbles of gas will form in the bottom and along the sides of the jar. If these are formed the starter should not be used, as gas fermentations always indicate impurity, and the effects of the starter will not be good.

The amount of starter that should be used in the cream will vary under different conditions. Ordinarily, if one is churning every day, about 1 to 1½ gallons of starter in 10 gallons of cream is the right proportion. If it is necessary to hurry the process of souring, more starter can be used, and vice versa. The temperature at which the cream is set will influence the amount of starter to be used. If the cream is cooled to about 60° F., it will require more starter than if it is set at 70° F. Unless the butter maker has means of controlling the temperatures quickly, either by very cold water or by means of ice, it is best to have the cream as cold as well water will make it (which will usually be about 60° F.) when the starter is added. If the cream is to be held for the next eighteen or twenty hours at this temperature, the amount of starter to be added can be determined by the butter maker after two or three trials. Attempt should be made to add just enough starter to have the cream soured properly at

churning time. No absolute rule can be given that can be depended upon for this work. The butter maker must use his intelligence and decrease or increase the amount of starter and raise or lower the temperature of the cream in such a way that it will be ripened and ready for churning at the right time.

If the cream is not to be churned every day, but must be held from two to four days before enough is secured for a churning, either of two ways may be followed: A very small amount of starter may be added to the first batch of cream, which will cause the gradual development of the acidity, or the cream may be held sweet from two to four milkings and then the starter added in a little larger quantity, with a view to having the ripening completed about twelve to eighteen hours after the last batch of cream is added. Here again the butter maker must use his judgment and experiment until he finds just the right quantities and the right time to add the starter.

Whole milk can be used for making a starter, as well as skim milk, but it is usually considered best to use the latter. The surface of the starter should be skimmed off for a half inch or so in depth and thrown away. This is necessary because in opening the jar for examination or for any purpose dust may have entered and formed colonies of undesirable bacteria which will be growing on the surface but have not reached any depth into the milk. When whole milk is used this skimming is not desirable on account of the loss of butter fat that would have risen to the surface.

It is sometimes necessary, in order to secure a good starter, to save a number of samples of milk and select the best from the lot. When an exceptionally good starter is secured it can be propagated from day to day by adding a small portion of it to a quantity of sweet skim milk, enough milk being used to make the necessary amount of starter for the cream to be churned. This controls the souring of the milk just the same as the addition of starter to the cream controls the souring of the cream. Where one is churning every day this is a very good method for carrying forward the starter. In fact, it may be used when but two or three churnings a week are made just as satisfactorily, discarding the lots on the days there are no churnings.

Under factory conditions, where mixed milk from a number of herds is used, it is always necessary to heat the milk intended for the starter to near the boiling point to destroy the bacteria that it may contain, and then renew the germ life in it by adding a portion of a well-ripened starter, but under farm conditions there should be no necessity for this. The milk should be so clean and so pure that the only decomposition which takes place would be that of souring, and it will usually be found that this souring gives the pleasant acid taste to the milk that is desirable in the butter.

When an attempt is made to ripen the cream without the addition of a starter the results are not usually as good. An example of what takes place in cream can be readily seen after one has some experience in making starters. Very often one sample of milk will not develop the desirable flavors, but will become entirely unfit to use in the cream as a starter, while another sample, perhaps taken from the same day's milking, will sour with a fine flavor. The cream contains the bacteria that developed in both of these starters, and each kind has equal chance to develop, unless a large quantity of the right kind is introduced, these overcoming the undesirable kind present and thus controlling the changes which take place. This is the purpose of the starter.

When cream from several separations is collected, the churning should not be made for a number of hours after the addition of the last batch of cream. Unless this time is given the fresh cream added will not have soured, although it will be mixed throughout the mass of sour cream, and if churned in this condition much butter fat will be lost in the buttermilk. Time must be given for complete and thorough blending of the various lots so that they are practically one, the acid being developed in all alike. This may be done very nicely by taking the previous night's separation as the last and churning the next day, thus giving ample time for the proper ripening of the last cream added.

During the last few hours of ripening there should be taken into consideration the temperature at which the cream must be churned. When it is completely ripe or has reached that point where the flavor is fine and the aroma good, it should be quickly brought to the temperature necessary for churning, if not already at that temperature. If it has to be lowered several degrees, it should stand at the churning temperature for a period of three or four hours before churning. This becomes necessary because the butter fat is a poor conductor of heat and takes longer to change in temperature than the milk serum. Everyone is familiar with the fact that oils and fats cool very slowly.

During the process of ripening, the cream should be stirred occasionally to obtain best results. Just what is the result of stirring is not entirely known or why it is necessary, but it is known that cream when frequently stirred ripens with a more uniform and finer flavor than cream which is ripened without stirring.

Flavors in cream.—In speaking of flavors, so far only acid flavors have been mentioned. There are undoubtedly desirable flavors in cream that do not come from the development of acid. Just what these are is not known at the present time, but the rich creamy flavor, or, as it is sometimes described, the nutty flavor, of a fine quality of cream is a combination of acid and other flavors. The butter maker

quickly recognizes this fine combination of flavors when he has once become familiar with it, and always looks for its development in his cream.

In the discussion of ripening and flavors, the effect of feed on flavor has not been taken into account. That different feeds will flavor milk and its products is known. Onions, leeks, turnips, and all similar strongly scented plants impart their flavors to the milk. It is commonly thought that the fine clover and timothy pastures common to some sections give a peculiarly fine flavor to milk. Before the science of ripening cream was developed to its present stage these ideas had more influence than they have now. Onions, garlic, and plants of this character still are very troublesome and often ruinous. About the only effective way to combat troubles from this source is to rid the pastures of them, which is easier said than done. Pasteurization of the cream will help to overcome this difficulty, but this adds to the expense. At the present time knowledge regarding the possibilities of producing a fine flavor by means of feed is not very great.

THE ACID TEST.

The only standard that has been applied in measuring the ripening of cream is the determination of the acid present. The acid test, as it is called, gives a fair idea of the quality and stage of ripeness. It is true, however, that two lots of cream may have exactly the same amount of acid and one of them be good and the other bad; so, after all, the acid test is not infallible. There is no step in the whole process of making butter where the judgment of the maker is so much needed as in ripening the cream. He must cultivate his taste for the desirable flavors and must know when the point is reached where further ripening must be checked. Neither the butter maker who depends entirely upon the sense of taste and smell, nor the one who depends entirely upon the acid test, will get the best results.

Methods of learning to taste and smell, or judgment in their use, can not be given in a book. The ability must be developed through experience. The acid test, however, is a mathematical calculation capable of exact determination.

The principle and its application.—As already stated the measure of ripeness of cream can be determined in a general way by the amount of acid it contains. For the purpose of determining the amount of acid, different methods have been devised, but all are based on the principle that an alkaline substance in solution will neutralize an acid solution. The manipulation of the different tests is practically the same although the apparatus differs somewhat in character. In every instance an alkaline solution of known strength is used. This is added to a definite quantity of cream until it exactly neutralizes the acid in the

cream. The amount of alkali necessary to do this measures the quantity of acid present. In order to tell just when the right point is reached and all of the acid is neutralized, a coloring matter, called an indicator, is added, which is pink in an alkaline solution and colorless in an acid solution. Sometimes this coloring matter is added to the alkaline substance used to make a test, as in the case of certain alkaline tablets. As the solution containing the indicator is added to the sour cream it shows no color until the point of neutrality is reached. At this point color gradually appears and becomes permanent. In other forms of the test it is necessary to add the coloring matter or indicator to the cream before beginning the test, three or four drops being sufficient to give the proper color when the cream becomes alkaline.

Farrington's alkaline test.—The two most common forms of the acid test are known as Farrington's alkaline test and Mann's acid test. In the former the alkaline substance is put up in the form of tablets of a uniform strength; the indicator is added to the tablet and gives it its pink color. The best method of using these tablets is described as follows:[a]

> The apparatus required is a 100 c. c. cylinder, a 17.6 c. c. pipette, and a white porcelain cup. Clean soft water to the amount of 97 c. c. is placed in the cylinder and five tablets are dissolved in it. The cylinder should be tightly corked and laid away until the tablets are entirely dissolved. If tablets and water are put in the cylinder in the evening they should be ready for use the next morning. In making the test, take the 17.6 c. c. pipette, measure that quantity of cream and place it in the clean cup. Rinse out the pipette with a small quantity of clean water and add the rinsings to the cream in the cup. Pour a few cubic centimeters of the tablet solution into this cream, giving the cup a rotary motion with the hand so as to thoroughly mix the solution with the cream. Add a few drops at a time until a slight pinkish color appears and remains permanent. The amount of alkali used can then be read off on the cylinder. The number so obtained represents the per cent of acid actually in the cream.

In making tests of this kind, in order to have results that will be uniform, exactly the same shade of pink, as near as it is possible to determine with the eye, should be observed each time. There are various other methods for using the tablet test, but the one given is the simplest and gives a direct result which needs no further computation.

Mann's acid test.—In using Mann's acid test the alkaline solution is procured in the form of a solution of known strength. This solution, added to the cream by means of a burette, determines very readily the acidity of the cream. In using this test a few drops of indicator will have to be added to the cream before the alkali solution is added. The amount of solution is read directly from the scale on the burette. This does not give the percentage of acid in the cream, as in the case of the tablet test, but gives a relative factor, which has to be worked

[a] Testing Milk and Its Products, by Farrington and Woll.

out by the following formula in order to reduce to percentage: Multiply the number of cubic centimeters of alkaline solution required to produce the pink color by 0.9 and divide the result by the number of cubic centimeters of cream used in making the test. The result is the per cent of acid in the cream. For the mathematical explanation of this formula and a more extended description of the acid test, the reader is referred to publications on the subject of testing.

In order to secure uniform results, the butter maker should see that his cream runs practically uniform from day to day in butter fat, and develops about the same amount of acid for each churning. The degree to which the ripening should be developed will depend largely on the demands of the local market where the butter is sold.

THE CHURN.

No other utensil in connection with dairying has received as much attention from inventors as the churn. Most of the efforts along this line have been to get a churn that would annihilate time. The thirty to forty minutes spent in churning has seemed a prodigious waste to the hustling inventor. The one-minute churn has been the goal. In round numbers, there have been more patents issued by the Patent Office on churns than on any other one thing.

A careful analysis of the junk in the attic or storehouse of the average dairyman will reveal one or more relics of this kind, due to the persuasive powers of an agent who had convinced him that he was foolish in spending so much time at the churn. In spite of all this activity for an improved article, the greater number of churns in use to-day are either the old-fashioned dasher churn or the equally old revolving barrel or box churn or its later modification, the combined churn and worker. Of these types the barrel churn is by far the best. Practically all factory churns in this country are modifications of it. This form has stood the test of time, and, until some genius gets up an entirely new method of making butter, it will be used to the exclusion of all the claptrap quick-churning machines ever invented.

Barrel churn the best.—Taking the barrel churn as best for the farm butter maker, he should know how to get the most out of it. In this form of churn the concussion of the cream necessary to do the churning is secured by the fall of the cream as the churn is revolved. The faster the churn is revolved the greater number of concussions per minute will be secured. But if the churn is whirled so fast that the centrifugal force created holds the cream from falling no churning will take place.

Cleaning the churn.—Churns are usually made of wood, and their care is an important factor. When ready to clean, the churn should

be rinsed out with cold water to remove all buttermilk, salt, etc.; it should then be partially filled with boiling water, the lid put on and fastened loosely, so steam can escape, the draining plug withdrawn, and the churn whirled. The pressure on the inside caused by the creation of steam from the hot water will force water into every nook and crevice of the churn. After a few revolutions the water should be drawn off and another lot, boiling hot, added, and the whirling repeated. Empty this out and let the churn stand so it will drain a few minutes, and then turn the opening up and let it dry. The heat in the wood will dry it out rapidly, and there will be no chance for mold to grow. An occasional rinsing out with lime water will help to keep a churn sweet.

All other wooden dairy utensils should be rinsed, scalded, and dried with the same care.

CHURNING.

The process of churning is the gathering into a mass of the butter fat in the cream. The butter fat exists in the cream in minute globules, each independent of the others, and any agitation tends to bring them together, the force of the impact causing them to adhere to each other. As the agitation is continued these small particles of butter grow larger by addition of other particles until a stage is reached where they become visible to the eye, and if the churning is continued long enough all will be united in one lump of butter in the churn.

Temperature.—The time that it takes to churn depends largely on the temperature of the cream at the beginning. If the cream is quite warm, the butter will come very quickly; if it is too cold, the churning may have to be prolonged, in some instances for hours, before the butter granules will become large enough to free themselves from the buttermilk. The temperature at the beginning should be regulated accordingly. It is usually considered that about thirty to thirty-five minutes' churning should bring the butter. With different seasons of the year the temperatures will have to be varied somewhat, in order to have the butter come in this length of time. It is necessary in hot weather to churn at a temperature as low as 50° or 55° F., while in the winter months, when the cows are on dry feed and the weather is cold, it is often necessary to raise the churning temperature to 60° or 65° F. Cases have been known where under some peculiar feed condition the temperature had to be raised to as high as 80° F., in order to make the butter gather at all. Trouble of this kind rarely ever occurs when the cows have succulent feed in winter, such as silage or roots. Occasionally some peculiar fermentation takes place in the cream, causing difficult churning, but this is a result of carelessness somewhere, and can be remedied by a thorough cleaning up of the premises.

Washing and salting the butter.—It is important to know at just what point to stop churning. For best results in freeing the granules from the buttermilk and incorporating the salt it is considered that the butter granules should be about the size of beans or grains of corn, possibly a little larger. The churn is then stopped, and the buttermilk allowed to drain. After the buttermilk is well drained from the butter granules an amount of water about equal in volume and of the same temperature as the buttermilk should be added, and the churn given four or five revolutions, slowly, so that the water will come in contact with every particle of butter and wash out the remaining buttermilk.

As soon as the wash water has drained well from the butter granules, salt should be added. The amount of salt used will depend entirely on the demands of the consumer. Usually about 1 ounce of salt for each pound of butter will be necessary. If the ordinary barrel churn is used, which is perhaps the best form made, the salt may be added in the churn. By giving the churn a few revolutions the salt will be quite thoroughly incorporated with the butter. It should stand in this condition for a few minutes, until the salt becomes more or less dissolved, before the working of the butter is begun.

WORKING THE BUTTER.

Table workers.—For working the butter some form of table worker is best to use. The butter bowl and paddle never give as good results because the butter will almost invariably be greasy, owing to the sliding motion of the paddle over the butter. The table workers commonly used are of two kinds—one having a stationary bed and a roller, either corrugated or smooth, arranged so that it can be passed back and forth over the surface of the butter; the other having a movable bed, revolving on a center, usually under two corrugated rollers. Both of these forms will do good work if the operator understands their use.

Suggestions as to working.—If the salt and butter have been mixed in the churn the butter can be placed on the working table and the working begun at once. After the butter has been pressed out with the roller it should be divided in the center, one part being laid over onto the other and the rollers passed over again. The process should be repeated until the butter assumes what is termed a waxy condition. If the working is continued for too long a time the butter will become salvy, having the appearance of lard, and will lose its granular structure, becoming weak-bodied. The firmness of the butter must be taken into account in determining how long it should be worked. Usually the firmer the butter the more working it will stand and the more time it will need to thoroughly incorporate the salt and bring out the waxy condition.

Testing saltiness while working.—During the process of working, the butter should be tested frequently to determine its saltiness, and if by mistake too much salt has been added it can readily be removed from the butter by pouring a little cold water over it as the working continues. The water washes out the excess of salt. If the butter should contain too little salt, more can readily be added during the process of working. It is best practice to about half finish the working and then let the butter stand for about twenty minutes or half an hour before completing. This gives the salt an additional chance to dissolve, and there is less liability of mottles in the finished product.

The remedy for mottles.—If after standing a few hours the butter is found to show a mottled appearance, this can be overcome by putting it on the worker and giving it an additional working. The mottled appearance indicates that some step in the working of the butter has not been thoroughly done. It is due to an uneven distribution of salt, and possibly to the presence of casein that has not been washed from the butter, the action of the salt on the casein forming lighter spots in the butter. The best remedy for mottles is to thoroughly wash the butter when it is in granular form before the salt is added, and then to work it until it has reached the waxy condition alluded to.

Water content of butter.—If the dairyman is using the combined churn and worker, the principles of working remain practically the same. The butter must be watched to determine just when it has been worked enough and to determine its condition in regard to the salt it contains. If butter is worked in the presence of water it has a tendency to take up water and increase the bulk of butter made. On the other hand, if the water is allowed to drain thoroughly from the butter as it is being worked, the tendency is to have drier, firmer-bodied butter. The water content will vary from 6 or 8 per cent up to as high as 14 or 15 per cent, depending upon the method the operator uses in working and on the temperature of the butter when it is churned and worked. If butter is churned so warm that it comes very soft, the granules contain larger quantities of water, and in this soft condition it can not be worked as much as a firmer butter. The presence of this moisture, together with the smaller amount of working, results in retaining the moisture in large drops, and the butter will have a wet or sloppy appearance. Firm butter worked in the presence of water will take up the water in minute drops, giving the butter a drier appearance.

These steps in working butter, like other operations, demand the exercise of judgment in the person who is doing the work, and one must experiment with conditions which surround him and find just what method is best to pursue. Butter will stand considerable

working if rollers are used that do not slide over the surface, making it smeary.

Care of utensils.—The worker, paddles, and prints that come in contact with the butter need special preparation before the work is begun. They should first be thoroughly scalded, and the scalding should continue long enough to make the surface of the wood hot, after which it should immediately be rinsed with cold water. This operation opens up the pores of the wood and then causes them to contract and form a smooth surface to which the butter will not stick. It also thoroughly wets the surface, which probably has a tendency to prevent the butter sticking.

PACKING BUTTER.

Value of appearances.—The size and style of package to be used in packing butter will depend entirely on the market conditions where the butter is sold. While great stress has been laid on the quality of butter made, it must also be borne in mind that the method by which it is packed and the neatness with which it appears on the market have practically as much to do with its sale as has its quality. In fact many buyers will select a neat package of butter in preference to one that is put up in a slovenly manner, even though the quality may not be as good. It is undoubtedly true that the average man or woman will judge an article of food as much by its appearance as by its general qualities. An unattractive article does not appeal to the sense of taste. It ought not to be necessary to say that a package of any kind must be neat and clean in appearance, but a large portion of the farm butter that comes into market shows that a great many makers do not realize the importance of this part of their work. Many lots of otherwise good butter are sold every day at a discount because of the slovenly methods of packing. The demands of the market on which the butter is sold should be carefully studied, and the package made of a size and form that will meet those demands.

Butter in tubs.—If the butter is to be put up in tubs, the packing should be so done that the butter will be solid throughout its entire mass. Too frequently the butter is thrown in without sufficient packing, and large holes will appear in the body of the butter. While these may not affect the quality they affect the appearance. If a parchment paper lining is used in the tub it should be put in smooth and the top should be turned neatly over the edge of the butter. Coverings that are put on the top, whether circles of parchment or cloth made for the purpose, should exactly fit the top of the package. Care should be taken that the tub does not show finger marks or other dirty spots.

Butter in small packages.—It is becoming more common for the markets to demand that butter be packed in small packages, such as

pound prints or squares. Butter put up in this form should be neatly wrapped in parchment paper. It is an excellent idea for the dairyman to have his name or label printed on the parchment. This helps to establish the identity of the goods, which, if properly made, should aid the dairyman in finding a permanent market for them. Wooden packages of almost any size can be secured for packing the prints. These should be used, particularly if it is necessary to ship the butter to market. For local distribution, light crates or boxes which will fit the prints and prevent them from getting out of shape in hauling should be used.

Refrigerator boxes.—In the summer months it is a hard matter to transport butter from the dairy to the market, and keep the prints in shape, unless the dairyman has ice for this purpose. Light refrigerator boxes are manufactured which can be used to great advantage, as their use will keep the butter hard and firm, and enable the maker to deliver it in that condition to his customers in the hottest weather. No one likes to buy a parcel of butter that is so soft that it can hardly be handled, and the good dairyman will not attempt to place butter on the market in that condition.

MARKETING THE BUTTER.

The markets which are accessible to the farm butter maker are of course dependent largely on local conditions. Almost any fair-sized town will furnish a local market for a quantity of first-class butter.

Selling direct to consumers.—Usually in these places a premium above the average market price can be secured by selling the butter to private customers who have regard for quality in products of this nature. This method of marketing of course involves more labor, but if the time can be spared for delivery it will give greater returns than any other method. It also enables the maker to establish a reputation for his goods such as he can not secure if he is compelled to place his butter with the general mass of butter that comes to the stores. If the dairyman attempts to build up a market of this kind he must be sure that he can always supply regularly those with whom he is dealing. If he can not do this misunderstandings and disappointment are liable to occur.

If the maker is compelled to take his butter to stores, he usually has to take the average price given for butter regardless of quality. A few storekeepers will recognize certain lines of butter as being superior to others and will pay more for them, but usually not as much as can be obtained by private marketing. In most localities, particularly during the summer months, the markets are flooded with farm butter and the prices are very unsatisfactory. The maker who

is depending on the stores for the sale of his butter usually has to accept the current price, while if he has worked up a private trade the chances are that he has a market that will give a uniform price throughout the year, which is a great advantage. There is little opportunity for the farm butter maker to ship his butter to distant markets, unless he is acquainted with the dealers or brokers who are to handle his product.

Patronizing creameries v. making butter.—Should the dairyman be compelled to take the average store price for his butter, he can generally do better by selling his milk or cream to a creamery, if there be one in easy reach, as the price for farm dairy butter is usually lower than the quotations for butter fat. In sections where creameries abound it is a question whether or not the dairyman can afford to make his own butter and spend the time looking for a good market in which to sell it. By the time he has added to the cost of his butter fat the work and worry connected with the making of the butter, which is too frequently done by the housewife, the amount actually saved is very small, and even though it is gain in dollars and cents it may not be worth the time and labor expended. Only on dairy farms where there is ample help to do the work can there be profit in making the butter at home.

STORING OR HOLDING FOR MARKET.

The amount of butter that the farm dairyman can store or hold for any length of time for market is necessarily limited. The old methods of packing butter down in brine or salt, such as were followed by our grandparents, has practically no place in modern methods of dairying. Cold storage such as the dairyman would probably have is not suitable for keeping butter any length of time, because such storage is not cold enough to answer the purpose. Modern storehouses for butter have temperatures from 5° to 10° below zero. It is now considered that anything above that temperature is not cold enough to properly preserve the butter and check the development of bad flavors. These temperatures, of course, are out of the reach of the dairyman. If ice is at hand and a good refrigerator or cooling room is available the butter may be stored for a short period with more or less success. The temperature of a good ice-storage room would probably not be below 40° or 45° F. unless special and expensive construction is made. It is sometimes necessary for a dairyman to keep the butter until a sufficient quantity has accumulated for profitable shipment. When this is done the butter should be packed in the ordinary way and kept as cold as possible until delivered to the market.

Rooms that are used for purposes of storing butter should be dry and free from mold. Too frequently ice-storage rooms are just the

reverse; they are excessively moist, which condition is favorable to the production of mold. Butter placed in a room of this character becomes quite moldy after a few days, which of course destroys its highest value as a product on the market. It is possible to construct rooms so that the circulation of air in them will be dry.

The interior of rooms of this character should be either whitewashed or painted with a good paint and shellac. From the sanitary standpoint the whitewash is better, as it has a tendency to destroy mold growths and keep the air pure and sweet. A room of this kind used for butter should not be used for other products of any kind, unless it be milk or cream. It is usually not a profitable undertaking for a dairyman to hold his butter in anticipation of higher prices. The butter is never so good as when it is fresh, and in that condition will give the best satisfaction to the consumer and in the long run will make more money for the dairyman. If any attempt is made to furnish a customer with butter that is "off" in flavor it always results disastrously to the dairyman. He can not afford to do anything that will tend to discredit his work or make the customer feel that he could do better elsewhere.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number and title of each. Copies will be sent to any address on application to any Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture, Washington, D. C.

No. 22. The Feeding of Farm Animals. No. 24. Hog Cholera and Swine Plague. No. 25. Peanuts Culture and Uses. No. 27. Flax for Seed and Fiber. No. 28. Weeds: And How to Kill Them. No. 29. Souring and Other Changes in Milk. No. 30. Grape Diseases on the Pacific Coast. No. 32. Silos and Silage. No. 33. Peach Growing for Market. No. 34. Meats: Composition and Cooking. No. 35. Potato Culture. No. 36. Cotton Seed and Its Products. No. 37. Kafir Corn: Culture and Uses. No. 38. Spraying for Fruit Diseases. No. 39. Onion Culture. No. 41. Fowls: Care and Feeding. No. 43. Sewage Disposal on the Farm. No. 44. Commercial Fertilizers. No. 46. Irrigation in Humid Climates. No. 47. Insects Affecting the Cotton Plant. No. 48. The Manuring of Cotton. No. 49. Sheep Feeding. No. 50. Sorghum as a Forage Crop. No. 51. Standard Varieties of Chickens. No. 52. The Sugar Beet. No. 54. Some Common Birds. No. 55. The Dairy Herd. No. 56. Experiment Station Work—I. No. 57. Butter Making on the Farm. No. 58. 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